

Climate Pollution Reduction Grants – Albemarle County Public Schools

Section 1 - Overall Project Summary and Approach

1.A - Description of GHG Reduction Measures

1.A.1 Abstract - Albemarle County Public Schools (ACPS) is seeking funding to design and implement a geothermal HVAC retrofit at Monticello High School (MHS) in alignment with the County's Climate Action Plan and ongoing commitment to improving the climate by reducing greenhouse gas (GHG) emissions. Early energy models estimate an annual GHG reduction of 325,000 kg of CO₂ resulting from the increased efficiency and the elimination of onsite natural gas combustion. Co-benefits of the project include energy cost savings and improved indoor air quality.

1.A.2 Background – Located near the eastern edge of the Blue Ridge Mountains of Central Virginia, Albemarle County's 726 square miles surround the City of Charlottesville. The diverse and densely populated urban ring gives way to rural areas. The County's population has been steadily rising at an average rate of 24.5% since the 1960s to a current population of approximately 115,000 according to 2023 ACS Census data.

Adopting both climate pollution reduction goals and a Climate Action Plan in October of 2020, Albemarle County and ACPS are committed to doing their part to address climate change. The School Board set a goal to reduce the community's emissions to net zero by 2050. As required by the CAP, the County is currently co-leading a process to develop a Climate Adaptation and Resilience Plan, and ACPS is a key partner in that effort.

The ACPS Advisory Committee on Environmental Sustainability (ACES) was formed to advise and inform the School Board and Superintendent about measures to help ACPS develop and reach sustainability goals. The ACES Charter notes that a "significant part of ACES mission will be to guide and coordinate the implementation of the County's Climate Action Plan as it relates to schools." The ACPS Energy Management and Conservation Policy (2015, amended 2021) supports the CAP and is intended to reduce energy consumption in school facilities. Additionally, ACPS's Sustainable Building Policy (1993, amended 2023) states in part that "New buildings and additions will prioritize elimination of onsite combustion of fossil fuels."

ACPS serves nearly 14,000 students, of whom 35% are non-white, 30.4% are economically disadvantaged, 13.0% have disabilities, and 11.9% are English learners. Students learn and thrive among ACPS's 24 traditional school facilities including 14 elementary schools, 5 middle schools, 3 high schools and one combined middle/high charter school in addition to several specialty education centers. The school division is in the design phase for 3 new net-zero ready school buildings needed to manage overcrowding and other capacity concerns associated with the County's increasing population.

Monticello High School shares its name with the home of the 3rd U.S. President, Thomas Jefferson, which is located less than a mile from the school. Built in 1998, the 261,000 square foot building is 26 years old. An additional 14 classroom academic space was added in 2003, followed by an athletic wing addition in 2006, and an 850-seat auditorium was added in 2007. The school serves 1170 students and 175 staff members.

In 2023, Monticello High School's energy usage was 12.36 million kBtu, the highest usage among all county-owned facilities. The school's energy use intensity (EUI) is 51 (kBtu/ft²/year) and the building's EnergyStar score is 65 out of a 100, falling below the threshold of EnergyStar Certification.

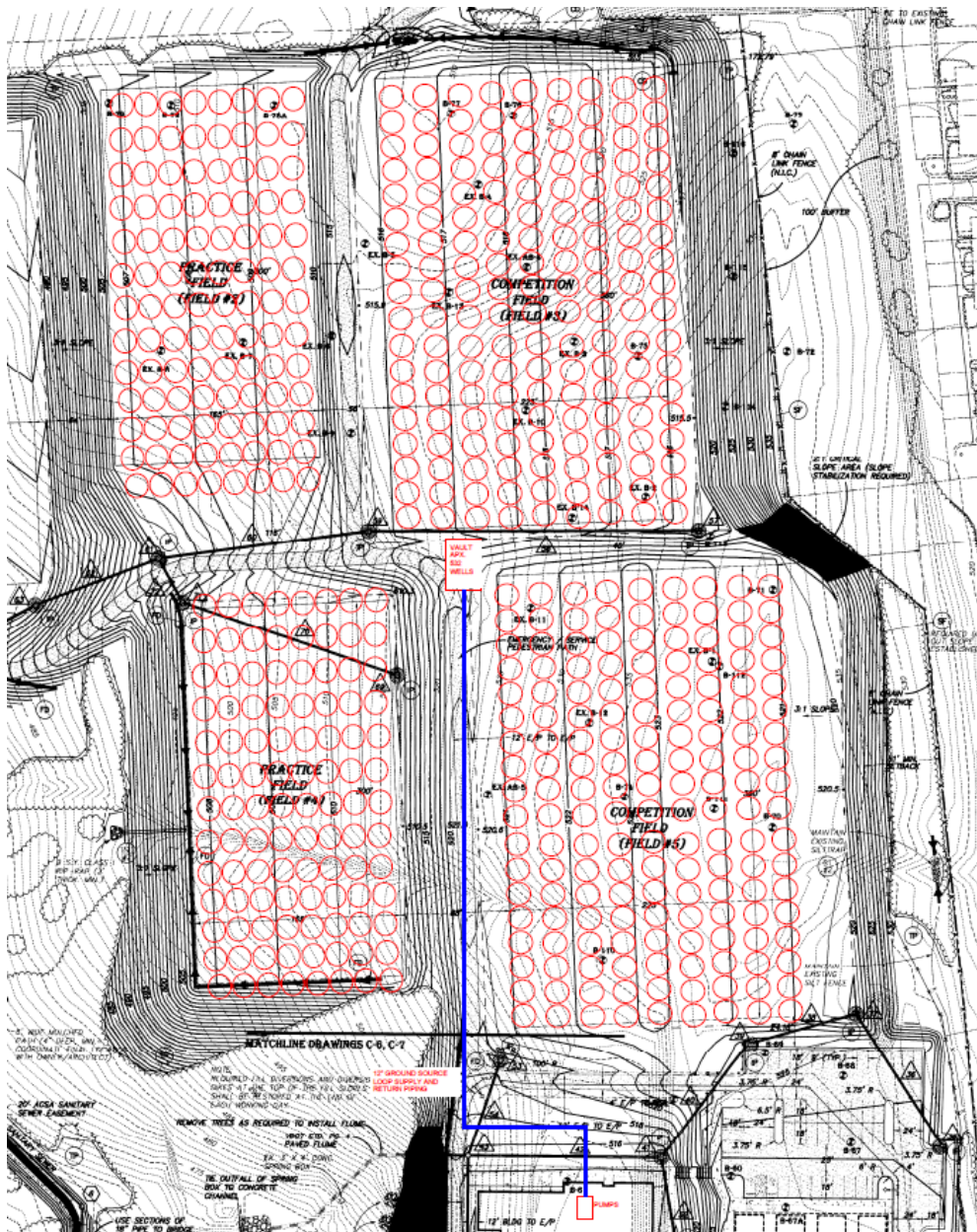


Figure 1 - Proposed Layout of Geothermal Well Field Over Existing Athletic Fields

1.A.3 GHG Reduction Measure Description –

Albemarle County is proposing to concurrently install a geothermal well field while retrofitting the building's HVAC infrastructure with new, high efficiency HVAC equipment. The project is expected to reduce energy usage by 3.75 million kBtu annually, resulting in an emissions reduction of 325,000 kg of CO₂e reduction and a projected savings of \$58,000. Energy savings and GHG reductions were calculated through energy models prepared in OpenStudio. Models were created to simulate current conditions in the school compared to the

proposed project design. Models were calibrated using MHS utility consumption data from the previous 12 months.

The project's emissions reduction estimate was calculated using energy models prepared in OpenStudio. Two energy models were developed, one based on the existing HVAC system, and another based upon the proposed geothermal HVAC system. The total energy usage calculated by each model was then multiplied by emissions factors for each model's respective fuel source. Emissions factors for each fuel source, retrieved from EPA's eGRID and EPA's "Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 – 2021," were multiplied by the modeled energy usage. The GHG emissions avoidance was calculated by the difference between these two models. The geothermal well field will consist of between 400 to 532 wells depending on thermal conductivity of the wells. A more accurate number of

wells will be determined as thermal conductivity results are received from test wells. For the sake of this application, we assume installation of 532 wells, but anticipate that the final number of wells will be less and that the total project cost will be adjusted accordingly. Each well will be 500 feet deep and will be spaced 20 feet apart. Wells will be located beneath the school's athletic fields and the project budget includes an allowance to restore the athletic fields following the installation of wells. Piping from the wells will feed into a single vault where 12-inch supply and return lines will carry the supply and return water to a pump vault containing four base mount end suction pumps with variable frequency drives. Pumps will deliver water to the school's heating and cooling plant. See Figure A for details of the proposed well field layout.

Monticello High presently has one large HVAC plant which serves the main portion of the school and a secondary plant serving the 14-classroom 2003 addition. The main plant presently houses seven natural gas burning boilers and a 1000-ton air to water chiller and x natural gas burning hot water heaters. This equipment will be removed and retrofitted with a 700-ton ground-source water cooled chiller with heat recovery for hot water. Additional geothermal hot water heat pump units will be installed to provide hot water to the building during times of mild temperatures when the chiller plant is not operating. Hot and chilled water will flow through the building's existing 4-pipe system to the building's air handlers which are being retrofitted in 2024/2025 outside of the scope of this project. Similarly, smaller-scale equipment will be retrofitted into the mechanical plant of the 14-classroom addition.

The following work schedule overview in Table 1 identifies major project milestones. The work breakdown structure in Table 2 provides a list of major tasks and reiterates milestones critical to the successful completion of the project. The work breakdown structure also identifies areas of risk in the project by introducing go/no-go points. Table 3 provides more details on each of these points, which are intended to be critical points of uncertainty/risk in the schedule where the project team should pause and evaluate whether the project should continue forward as planned. If the answer of the go/no-go analysis is no-go, then the project team will consult with project administrators at the EPA to determine next steps. These next steps may include, but are not limited to, accepting the risk and continuing with the project, adjusting the project's scope, or ending the project.

Table 1 - High-Level Work Schedule Overview

Year	Project Milestones
Year 1	<ul style="list-style-type: none"> • Thermal conductivity analysis to determine project feasibility • Team assembly • Project planning/phasing • Project design • Permitting
Year 2	<ul style="list-style-type: none"> • Begin geothermal work • Complete geothermal work • Begin Mechanical, Electrical, & Plumbing (MEP) upgrades
Year 3	<ul style="list-style-type: none"> • Complete MEP upgrades • Commissioning

Table 2 - Work Breakdown Structure (WBS) and Task Description Summary

<p>Year 1</p>	<p>1.1 - <u>Thermal Conductivity Analysis</u> (*) – Two test wells will be bored in two different locations to determine whether geothermal conductivity on the site is conducive to the necessary heat transfer required for a geothermal system.</p> <p>1.2 - <u>Project Planning & Design</u></p> <p>1.2.1 - Assemble/confirm engineering team – Based upon procurement strategy, the engineering team(s) for the geothermal fields and the MEP upgrades will be secured via existing term contracts or through a formal procurement process.</p> <p>1.2.2 - Develop strategy for project phasing (*) – Create a plan for phasing the various project stages that minimizes disruption to students while still delivering new systems and upgrades in a timely manner.</p> <p>1.3 - Create design drawings:</p> <p>1.3.1 - Issue design package for geothermal well fields – Create construction documents for well fields; interim design packages will be issued before the final package.</p> <p>1.3.2 - Issue design package for MEP system upgrades – Create construction documents for MEP system upgrades; interim design packages will be issued before the final package.</p> <p>1.3.3 - Obtain necessary permits (*) – In addition to stormwater management, erosion/sedimentation control, and building permits required for all commercial projects, geothermal well fields in Virginia are subject to Virginia Department of Health permit requirements. Permitting requirements will be confirmed, and all necessary permits will be sought.</p> <p>1.3.4 - Receive proposals and award contract to selected general contractor to construct and install geothermal well field and MEP upgrades.</p> <p>MILESTONE: Project design is completed and approved; project is ready to move to bidding and construction.</p> <p>1.4 - <u>Geothermal Well Field Construction</u></p> <p>1.4.1 - Bidding/procurement (*) –Subcontractors, Equipment, and Materials for the Geothermal well field will be bid out and procured.</p>
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Year 2	<p>2.1 - <u>Geothermal Well Field Construction (Cont'd)</u></p> <p>2.1.1 - Construction/Installation commences – Contractor begins boring geothermal well field and related infrastructure systems.</p> <p>2.1.2 - Construction/Installation completed – Contractor will complete well field and systems.</p> <p>MILESTONE: New geothermal wells & systems are completed.</p> <p>2.2 - <u>MEP System Upgrades</u></p> <p>2.2.1 - Bidding/procurement (*) – Materials and Equipment for MEP system upgrades will be procured.</p>
Year 3	<p>3.1 - <u>MEP System Upgrades (Cont'd)</u></p> <p>3.3.1 - Construction/installation – MEP Systems will be installed.</p> <p>MILESTONE: MEP upgrades are completed.</p> <p>3.2 - <u>MEP System Commissioning</u> – The owner's commissioning agent will evaluate the installation and proper functioning of all new equipment and systems to ensure that the system is functioning per the design.</p> <p>MILESTONE: Project Completed.</p>

(*) indicates a go/no-go decision point.

3 - Description of Go/No-Go Decisions Points

Year 1	<ul style="list-style-type: none"> • <u>Thermal Conductivity Analysis reports favorable conditions for geothermal well fields at each school.</u> If the analysis reveals unfavorable conditions for drilling, a decision would be made not to proceed with the project. • <u>Viable project phasing plans are developed for both geothermal well field construction and MEP system upgrades.</u> Phasing plans will allow for minimal disruptions to student instruction and programming. If disruptions to students are deemed to be too large, a decision may be made not to proceed with the project. • <u>All relevant and necessary permits are obtained for geothermal well fields at each school.</u> If any permits are rejected and no satisfactory alternative can be reached with the regulating authority, a decision will be made not to proceed with the project. • <u>Bids for geothermal well field materials and construction are within budget.</u> If the project cannot be completed within budget, a decision may be made to postpone or cancel the project.
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Year 2	<ul style="list-style-type: none"> • <u>Bids for geothermal well field materials/construction at MHS are within budget.</u> If the project cannot be completed within budget, a decision may be made to postpone or cancel the project at MHS. • <u>Bids for MEP equipment upgrades at MHS are within budget.</u> If the project cannot be completed within budget, a decision may be made to postpone or cancel the project at MHS.
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1.A.4 Project Connection to Virginia PCAP - The proposed GHG reduction measure presented here aligns with Measure 4 of the Virginia PCAP, “Increase residential and commercial building energy efficiency and identify and implement GHG emission reduction solutions at homes, businesses, and institutions.” This project aims to increase energy efficiency and reduce GHG emissions at a local government-owned facility.

1.B. Demonstration of Funding Need

ACPS serves nearly 14,000 students, of whom 35% are non-white, 30.4% are economically disadvantaged, 13.0% have disabilities, and 11.9% are English learners. Albemarle County’s population has increased almost fourfold since the 1960s. The school division is in the design phase for three new net-zero ready school buildings needed to manage capacity concerns associated with the County’s increasing population. Most of ACPS’s capital improvement budget has been devoted to increasing school building size to help alleviate overcrowding in the schools. Remaining dollars in the capital budget have gone to in-kind replacement of mechanical systems. The proposed type of GHG-reducing project simply cannot be funded without financial assistance from programs like the CPRG. This project, the geothermal HVAC retrofit at MHS, was ranked as the lowest priority of all capital funding requests presented to the school division’s Long Range Planning committee, with preference given to capacity generating projects.

This problem is further compounded by changes to Virginia’s Local Composite Index, the method used to calculate how much state funding each school division receives, which has left Albemarle County Public Schools with a \$10 million budget shortfall. While Albemarle County pulled funding from its own budget to close this gap, it leaves the county, as a whole, with a \$10 million shortfall. Deferred maintenance needs for MHS are estimated to be at least \$3 million with an additional \$1 million in maintenance needs projected in the next 5 years. The primary deferred maintenance item is an HVAC system upgrade, which would be addressed by the proposed project.

MHS serves 1170 students and 175 staff members. In 2023, the school’s energy usage was 12.36 million kBtu, the highest usage among all county-owned facilities. The school’s EUI is 51 (kBtu/ft²/year) and the building’s EnergyStar score is 65 out of a 100, falling below the threshold of EnergyStar Certification.

1.C. Transformative Impact

Most conversations around geothermal heating and cooling focus on new building construction, but this project would focus predominantly on decarbonizing and converting an existing school with ground source heating and cooling infrastructure. The median age for school buildings in Virginia is 52 years old, and only 15% of schools in Virginia have undergone a major renovation since 2015.¹ Additionally, studies have shown that renovations are a more sustainable solution than constructing replacement facilities due to the embodied carbon within existing buildings.² This project seeks to push the boundaries of sustainable facilities without the added carbon footprint of a replacement facility. The design will be key to achieving this aim. By using a dedicated heat recovery chiller for which the geothermal wells serve as the heat sink, the existing schools can keep their current hot water and chilled water piping infrastructure. This design choice is expected to save millions of dollars, which vastly improves the economics of the project and makes this approach more accessible for other schools. This project could serve as a model for other ACPS campuses and other school divisions throughout Virginia and the country. ACPS would aim to widely share the results of this project via case studies, media, and conference presentations in order to inform other school districts about the opportunities, benefits, disadvantages, challenges, and best practices associated with a geothermal conversion paired with MEP system upgrades at both existing and new school facilities.

Section 2 - Impact of GHG Reduction Measures

2.A Magnitude of GHG Reductions from 2025 through 2030

This project would yield an estimated cumulative metric ton emissions reduction of **925 metric tons (Mt) of carbon dioxide equivalent (CO₂e)** by 2030. If EPA were to authorize funding of this project, it is estimated that it will take three years to complete, and thus three years before any operational GHG emissions reductions would be realized. We estimate an annual GHG reduction of 325 Mt of CO₂e beginning in 2028. 2030 emissions reductions include 0.57 Mt of methane (CH₄) and 0.01 Mt of nitrous oxide (N₂O). Nearly all GHG emissions from gas boilers are in the form of carbon dioxide (CO₂).³ Gas boiler emissions typically do not include hydrofluorocarbons, perfluorocarbons, or sulfur hexafluoride.

The project's strength as a GHG reduction measure is in its durability. HVAC infrastructure will be upgraded with a system estimated to have a 25–30-year service life. As such, we assess that the emissions reductions will be highly durable, lasting far beyond 2030, and likely permanent.

GHG reductions were calculated through energy models prepared in OpenStudio. Models were created to simulate current conditions in the school compared to the proposed project design. Models were calibrated using MHS utility consumption data from the previous 12 months.

Since CPRG funding will resource 100 percent of the funding needed for this project, we attribute all emissions reductions to CPRG funding should this grant be awarded. Additional emissions reductions are likely to occur due to MHS's electric utility's efforts to fully decarbonize its energy sources by 2045 under the Virginia Clean Economy Act, but those reductions are not included in our calculated total.

2.B Magnitude of GHG Reductions from 2025 through 2050

By 2050, this project will provide a cumulative emissions reduction of **7,475 Mt of CO₂e**. We estimate an annual GHG emissions reduction of 325 metric tons (Mt) of CO₂e starting in 2028. 2050 reductions include 2.46 Mt of CH₄ and 0.03 Mt of N₂O. Nearly all GHG emissions from gas boilers are in the form of carbon dioxide (CO₂). Gas boiler emissions typically do not include hydrofluorocarbons, perfluorocarbons, or sulfur hexafluoride.

The project's strength as a GHG reduction measure is in its durability and longevity. The indoor HVAC infrastructure has an expected service life of 25-30 years with the geothermal wells lasting as long as 50 years. As such, we assess that the emissions reductions will be highly durable, likely lasting beyond 2050, and likely permanent. Given our community's deep-seeded commitment to climate action, it is highly likely that the geothermal system will eventually be replaced with a system that has comparable life cycle GHG emissions, if not zero emissions. That system could be a geothermal system or one that has more environmental and societal benefits.

GHG reductions were calculated through energy models prepared in OpenStudio. Models were created to simulate current conditions in the school compared to the proposed project design. Models were calibrated using MHS utility consumption data from the previous 12 months.

CPRG funding will resource 100 percent of the funding needed for this project. We therefore attribute all emissions reductions to EPA funding should this grant be awarded. Additional emissions reductions are likely to occur due to MHS's electric utility's efforts to fully decarbonize its energy sources by 2045 under the Virginia Clean Economy Act, but those reductions are not included in our calculated total.

2.C Cost Effectiveness of GHG Reductions

The cost effectiveness of GHG emissions reductions will be \$25.3 million divided by 925 Mt of CO₂e, or approximately **\$27,400 per Mt**. The greatest cost associated with this project is the geothermal wellfield construction; however, this is also its greatest long-term asset. Each bore is expected to have a service life of 50 years or more, meaning that this system will continue to deliver GHG reductions for 50 years or more. When considering the estimated 325Mt GHG reduction over 50 years, the cost effectiveness drops to near \$2000 per megaton.

As the project involves converting from a fossil-fuel heating source to electricity, the project has the opportunity to realize further GHG reductions from renewable energy, whether from onsite renewables or as renewable energy makes up a greater portion of the region's electricity grid. The GHG emissions reductions do not account for the embodied carbon of the building's mechanical systems that will be reused, rather than replaced, by this innovative approach.

Lastly, bear in mind that the actual number of geothermal wells is to be determined based upon the thermal conductivity testing at the beginning of the project. The total number of wells required may be as high as 532 or as low as 400. Given this unknown, project pricing has been provided based on the maximum number of wells; however, it is possible that the number of wells and therefore the overall project may be less than estimated.

2.D Documentation of GHG Reduction Assumptions

2.D.1 - Models/Tools Used: We calculated GHG reductions through energy models prepared in OpenStudio. OpenStudio was collaboratively developed by National Renewable Energy Laboratory (NREL), Argonne National Laboratory (ANL), Lawrence Berkeley National Laboratory (LBNL), Oak Ridge National Laboratory (ORNL), and Pacific Northwest National Laboratory (PNNL)

2.D.2 - Measure Implementation Assumptions: The following are our key assumptions related to the implementation of the GHG emissions reduction measure:

Project milestones

- Year One - Thermal conductivity analysis to determine project feasibility; team assembly; project planning/phasing; project design; permitting.
- Year Two - Begin geothermal work; Complete geothermal work; begin MEP upgrades
- Year Three - Complete MEP upgrades; Commissioning

2.D.3 - GHG Reduction Estimate Assumptions: The following are our key assumptions used as part of the method for estimating GHG emission reductions:

- Emission factors:
 - Electricity 623 lb/MWh (eGRID 2022, SRVC Region)
 - Natural Gas 117 lb/MMBtu (EIA)
- The current emissions intensity of Monticello High School (MHS) is 6.32 kg CO₂e per square foot per year.
- Models were created to simulate current conditions in the school compared to the proposed project design. Models were calibrated using MHS utility consumption data from the previous 12 months.
- CPRG funding will resource 100 percent of the funding needed for this project. We therefore attribute all emissions reductions to EPA funding should this grant be awarded. Additional emissions reductions are likely to occur due to MHS's electric utility's efforts to fully decarbonize its energy sources by 2045 under the Virginia Clean Economy Act, but those reductions are not included in our calculated total.
- We identified no efficiency losses over time with the proposed geothermal system. While it is possible that natural gas may experience some decrease in emissions intensity, thereby decreasing the relative gains of a geothermal system over time, we assess that as unlikely. Further, we assess our assumption as conservative given the increasing climate costs of continuing to access natural gas as a fuel source. Therefore, we maintained consistent avoided emissions over the life of the system.
- MHS is served by Dominion Energy, which is obligated under the Virginia Clean Economy Act to shift its energy capacity to 100% renewable sources by 2045. However, we do not consider those emissions reductions in our calculations.

2.D.4 - Reference Case Scenario (GHG Emissions or Activity Level): Describe the reference scenario that is used to quantify GHG emission reductions for each measure, as applicable.

For example, an activity-level reference scenario approach might include a reference level of energy efficiency for a type of energy use equipment or GHG emission intensity under standard market practice for a type of activity, application, or equipment.

In contrast, a GHG emissions reference scenario approach might include documented base year GHG emissions for the application or sector where the GHG reduction measure will be implemented or projected future GHG emissions in the absence of the implemented GHG reduction measure.

For a reference scenario based on projected “business as usual” (BAU) GHG emissions, the timeframe of the BAU projection should align with the timeframe for quantified emission reduction estimates. Provide key assumptions that apply for the reference scenario(s) used. If using a BAU projection, indicate whether the BAU projection includes the effect of non-CPRG federal incentives (e.g., grants, tax incentives) provided through programs or legislation such as IRA, BIL, and/or CHIPS.

2.D.5 - Measure-Specific Activity Data: The following were used for estimating GHG emission reductions:

- The geothermal well field will consist of between 400 to 532 wells depending on thermal conductivity of the wells. A more accurate number of wells will be determined as thermal conductivity results are received from test wells. For the sake of this application, we will assume a scenario of 532 wells, but anticipate that the final number of wells will likely be less and that the total project cost will be adjusted accordingly.
- Each well will be 500 feet deep and will be spaced 20 feet apart.
- In the school’s main HVAC plant, the natural gas burning boilers, air-to-water chiller, and natural gas burning hot water heaters will be removed and retrofitted with a 700 ton ground-source water cooled chiller with heat recovery for hot water. Similar, smaller-scale equipment will be retrofitted into the mechanical plant of the 14-classroom addition.
- Additional geothermal hot water heat pump units will be installed to provide hot water to the building during times of mild temperatures when the chiller plant is not operating.
- Annually, the project is expected to reduce energy usage by 3.75 million kBtu.

2.D.6 - GHG Emissions Reduced:

- We estimate an annual GHG emissions reduction of 325 metric tons (Mt) of CO₂e starting in 2028.
- This project would yield an estimated cumulative metric ton emissions reduction of **925 Mt of CO₂e** by 2030.
- By 2050, this project will provide a cumulative emissions reduction of **7,475 Mt of CO₂e**.

Section 3 - Environmental Results – Outputs, Outcomes, and Performance Measures

3.A Expected Outputs and Outcomes

3.A.1 Climate change mitigation - The primary benefit expected as a result of this project will be mitigation of climate change through reduced GHG emissions. In recent years Albemarle County has felt the effects of climate change in this region. In recent years Albemarle County has experienced extreme heat, extreme cold, drought, flooding, wildfires and wildfire smoke, and extreme storms. In fact, Monticello High has experienced the effects of this extreme weather very acutely. In 2019, the school was in the direct path of a tornado during an extreme thunderstorm in our area. Windows were broken and steel doors were bent due to the pressure. The school has also served as an emergency shelter during other extreme weather events such as a winter storm in 2022 when more than 75% of county residents lost power for several days during sub-freezing weather. Albemarle County and Albemarle County Public Schools are committed to reducing GHG emissions within the county and serving as a leader within the Central Virginia region and beyond. This project showcases our commitment to mitigation climate change and its impact.

3.A.2 Improved Health & Academic Performance - Numerous studies have shown links between indoor combustion of natural gas and detrimental effects to human health and academic performance. A 1997 study by Pilott et al. noted a “significant increase” in sore throat, cold, and absenteeism in children ages 6 - 11 when exposed to nitrogen dioxide, a byproduct of natural gas combustion.² Another study links exposure to nitrogen dioxide with increased incidence of childhood asthma³. As a result of the acute and chronic health conditions that are caused and/or exacerbated by the combustion of natural gas in the building, student’s academic performance can also suffer due to absences associated with these health conditions. With the replacement of natural gas boilers with high efficiency electric HVAC equipment, Albemarle County expects to see the following outcomes among students and staff.

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| • Better academic performance | • Avoided respiratory symptoms |
| • Better work / learning environment | • Avoided lost work days |
| • Improved indoor air quality | • Avoided lost school days |
| • Improved health | • Avoided hospital admissions |

3.A.3 Increased Awareness of Renewable Energy and Geothermal HVAC Systems - The 2019 poll conducted by Ipsos/NPR shows that 86% of teachers feel that climate change education is important in public schools. A key tenet of Albemarle County’s Climate Action Plan is to “promote education on climate action for youth and adults”. Albemarle County Public Schools’ Advisory Committee for Environmental Sustainability is focused on the integration of topics related to climate change and sustainability into the curriculum. By implementing sustainable infrastructure projects, like this proposed geothermal HVAC retrofit, it allows us to ‘walk the walk’ - so to speak. To show students that the county and school division are committed to what is being taught in the classroom. This type of project also serves as a physical learning lab for students to see the types of projects and systems that will help to lower GHG emissions and mitigate climate change. Discussed in depth in the Community Engagement section of this application, plans to both develop a science curriculum around the

geothermal system and to add signage around the campus highlighting system components that will be visible to students and community members alike.

3.A.4 Improved Community Air Quality - The community adjacent to Monticello High includes a mix of multifamily apartments, single-family homes, two other primary schools with a third being constructed next year, a community college, and a commercial area. Not only will the building occupants experience the benefits of improved air quality, but so will the surrounding community at large. The boiler vents on the roof of the high school are located less than 200 feet from the neighboring apartments. These neighbors will benefit from reduced nitrogen dioxide and PM 2.5, resulting in a healthier community for both residents and students of the three nearby schools.

3.A.5 Energy Savings -Based upon the energy modeling described in section 1.A.3, the project, once completed, is expected to result in energy savings of approximately \$58,000 per year. Albemarle County is committed to GHG reductions and commits to use the annual operational savings from reduced energy use to fund additional GHG reducing projects.

3.B Performance Measures and Plan

3.B.1 Energy Benchmarking - Albemarle County Public Schools utilizes various web-based energy benchmarking tools to track all utility usage and cost data and to validate energy performance. Energy usage and cost data from the electric utility and on-site solar will be tracked and monitored with an expected decrease in overall energy usage. Each year county staff will consult the EPA's Emissions and Generation Resource Integrated Databases (eGRID) to determine the appropriate emissions factor to utilize when calculating emissions associated with regionally purchased electricity. As the RECs for the onsite solar system are not owned by the county, this emissions factor will also be applied to all energy generated from solar. A public facing dashboard that displays interactive energy, water, and emissions from school facilities is updated annually. Finally, all energy usage and cost data is transferred to the school district's Energy Star Portfolio Manager account. It is expected that Monticello High's EnergyStar score will improve dramatically as a result of the proposed project.

3.B.2 Sub-metering - In addition to energy benchmarking based upon utility bills, sub-meters will be installed to monitor all major system components, serving numerous benefits. First this allows maintenance staff to accurately monitor the performance of each major component and quickly identify components that may require investigation or maintenance. It also ensures that energy and GHG reductions are properly accounted for and not confused with any other fluctuations in building energy use. Finally, it ensures quick and accurate compliance with all reporting requirements associated with the grant.

3.B.3 Building Automation System - School facilities staff operate a comprehensive building automation system (BAS). This system allows staff to check and control system components and sensors remotely. Through the BAS, maintenance staff can schedule systems, monitor performance, adjust setpoints, and monitor energy and indoor air quality sensors. This system will allow staff to closely monitor the performance of the new geothermal system. Indoor air quality sensors will allow for the validation of expected indoor air quality improvements.

3.C Authorities, Implementation Timeline, and Milestones

3.C.1 Authorities - While Albemarle County Public Schools is not a municipal government, we are applying as an 'other municipal entity' as defined in the frequently asked questions information on the grant homepage which states, "Other municipal entities such as regional transit authorities, public housing authorities, port authorities, water, sanitation, and waste districts, public school districts, and flood authorities may be eligible to apply if they constitute a public body created by or pursuant to State law, and they are accountable to municipal or state units of government."

Albemarle County Public Schools, School Board policy AA defines the legal status of the school district as both a public body created by State law, and accountable to state government. The policy states,

"The Constitution of Virginia provides that the General Assembly establish a system of free public elementary and secondary schools for all children of school age throughout the state, and seek to ensure that an educational program of high quality is established and continually maintained. The General Assembly requires that such an educational system be maintained and administered by the Board of Education, the State Superintendent of Public Instruction, superintendents, and school boards as officers of the Commonwealth. The Board of Education divides the Commonwealth into school divisions of such geographical area and school-age population as will promote the realization of the standards of quality, and will periodically review the adequacy of existing school division for this purpose. The supervision of schools in the Albemarle County school division is vested in The School Board of Albemarle County, Virginia. The School Board is a corporate body whose official title shall be "The School Board of Albemarle County, Virginia."

Albemarle County Public Schools' Department of Building Services will be responsible for the design, implementation, operation, and ongoing maintenance of this project. The department's project management team will oversee the design and construction phases of the project. This team will, in accordance with all local, state and federal regulations, procure professional engineering services to design the system. Likewise, the team will select the general contractor (GC) to construct and install the new systems and will closely collaborate with the GC throughout the term of the project to ensure that a quality project is delivered within scope, on time, and within budget. School division project management staff will collaborate with Albemarle County's Climate Protection Management team to deliver required reports to the EPA.

3.C.2 – Timeline & Milestones – Figure 2, below, shows approximate timelines for major project milestones including time set aside for report preparation. The timeline aligns with the work breakdown structure provided in section 1.A.3. The project schedule will be finalized by the engineering team and general contractor.

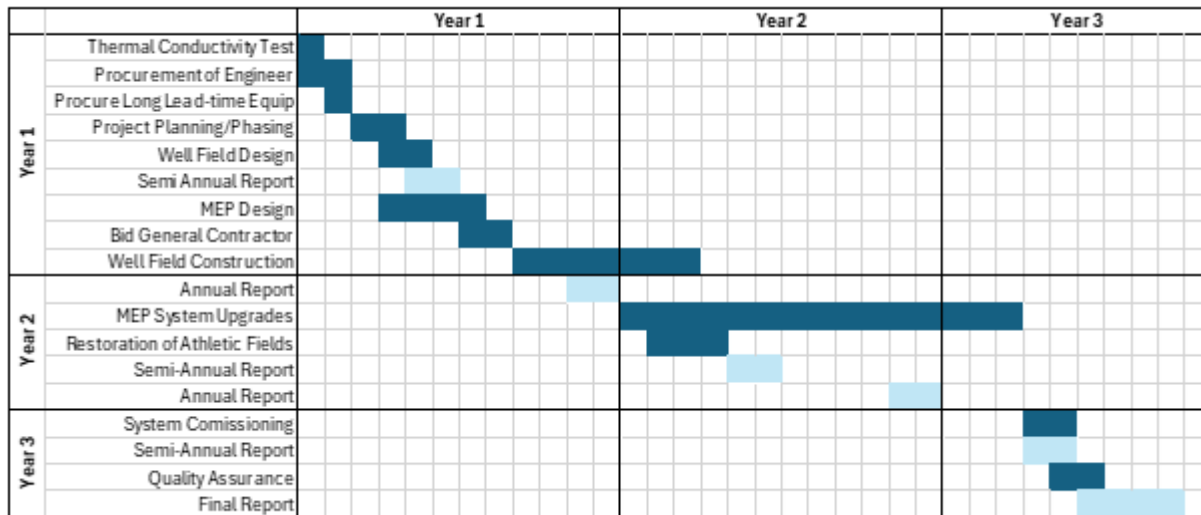


Figure 2 - Approximate timeline for major project activities and milestones.

Section 4 - Low-Income and Disadvantaged Communities

4.A Community Benefits MHS serves 35% non-white students, 30% of students are eligible for free and reduced lunch, and 14.5% of students have disabilities. The school's feeder pattern contains one HUD qualified Census Tract. Monticello high is designated as community shelter and has been used as such during recent times of community need. While the federal government annually awards 10% of its expenditures to disadvantaged businesses and state agencies strive to award 42% of its contracts to small, minority, and women-owned businesses, Virginia localities and school divisions are not legally bound to adhere to any disadvantaged business set-aside procurement requirements. However, ACPS has an established supplier diversity policy contained within its Purchasing Manual. ACPS has always been committed to pushing boundaries related to equity and inclusion. In 2019, ACPS was one of the first school divisions in the state and country to adopt an anti-racism policy, which states that "Albemarle County Public Schools is committed to establishing and sustaining an equitable community that achieves the School Division's equity mission to end the predictive value of race and ensure each individual student's and staff's success. The Albemarle County School Board and School Division reject all forms of racism as destructive to their mission, vision, values, and goals."

Because of the school division's commitment to promoting diversity, equity, inclusion, and accessibility, ACPS intends to actively market all aspects of this project to disadvantaged businesses. These may include minority- owned businesses, woman-owned businesses, and veteran-owned businesses for contractor support throughout all phases of the project. There may also be an opportunity to partner with the region's local technical education center – the Charlottesville Area Technical Education Center – to provide learning opportunities for disadvantaged youth and community members throughout the design and construction of the project via community workshops and stakeholder meetings. ACPS has a proven track record of engaging with students in this program and would seek to do so again with this project.

Climate change and its associated hazards, such as air quality, extreme temperatures, and flooding, disproportionately impact low income and disadvantaged communities (LIDACs). Decreasing emissions associated with MHS operations will play a role in mitigating climate change for LIDACs throughout the County. Across the US, people of color are more likely to live in areas with the highest expected impacts of climate change. Those impacts include increased mortality rates from extreme temperatures, increased rates of childhood asthma diagnoses, and labor hour losses.

MHS's 1170 students and 175 staff members spend more time at school than anywhere except home. Given that LIDACs have increased relative risk of poor air quality, poor air quality at school exacerbates that risk for students. Improving air quality for all MHS students will decrease the likelihood of students and staff from our LIDACs developing health complications such as asthma due to air pollutants. The most direct impact on student health will be through improved air quality and reduced exposure to harmful chemicals and fumes resulting from the natural gas-burning boilers. We estimate that replacing the current gas-burning system with geothermal will avoid a number of criteria air pollutants (CAPs) and hazardous air pollutants (HAPs), namely:

Pollutant	Abbr.	Category	2030	2050
			Reduction (lbs)	Reduction
Carbon Monoxide	CO	CAP	9535	41466
Nitrogen Dioxide	NO ₂	CAP	2783	15876
Particulate matter 10	PM ₁₀	CAP	56	323
Particulate matter 2.5	PM _{2.5}	CAP	1257	5539
Sulfur dioxide	SO ₂	CAP	37	192
Benzene	C ₆ H ₆	HAP	72	299
Formaldehyde	CH ₂ O	HAP	2	8

4.B Community Engagement

ACPS is committed to transparency through an iterative project planning process. This process ensures that all parties are supportive of the project before it enters the construction phase. MHS and feeder school community members will be well informed as to the benefits, costs, timeline, and impact of the conversion. A primary goal will be to ensure minimal disruption to student learning and staff development. ACPS will host one public meeting each at MHS and each middle and elementary feeder school to inform community members of the proposed plan and solicit input on planning considerations as well as perceived benefits and risks associated with the project. We will post all such meetings on the ACPS website along with sending information to community members through established school communication channels. Additionally, we will recruit one MHS staff representative to the project team to ensure the team is well-informed of changes that may need to be considered based on current MHS activities scheduling and other considerations.

Integrating community feedback on project benefits, ACPS will develop a multimedia campaign to inform the students, families, faculties, and staff of Monticello High School and MHS's feeder schools about renewable energy and geothermal HVAC systems. The campaign will include the various benefits of the system replacement, as well as our leadership in converting this system. One element of such a campaign that will allow us to reach beyond our local community members will be signage about the geothermal system at our sports fields. The fields are visited by athletes and their families from

throughout Albemarle County, the region, and Piedmont Virginia Community College. Additionally, ACPS will develop a supplemental teaching unit to integrate recognition of the school's infrastructure in environmental and earth science classes as well as in career and technical education classes at MHS as well as in MHS feeder schools.

ACPS has a history of engaging with underserved communities through partnerships with community organizations. (No Tribal governments exist within Albemarle County.) Prior to and during the COVID-19 pandemic, ACPS worked with the Southwood community, which is a low-income mobile home neighborhood owned and operated by the local Habitat for Humanity affiliate within the MVES and MHS feeder patterns, to engage with students and families to provide additional academic support, broadband access, and food and health resources. Additionally, the long-standing relationship between ACPS and the Boys and Girls Club of Central Virginia has resulted in the organization constructing their headquarters and central facility on an ACPS campus, allowing both organizations to collaborate more effectively on the common goal of equitably supporting students.

As Virginia is a Dillon-rule state, ACPS' authority to enter into contractual agreements with community and labor organizations is limited; however, ACPS is committed to engaging with the community and ensuring quality jobs for this project. ACPS commits to consulting community resources to develop a set of best practices for construction and labor on this project, including fair and equitable wages and benefits that align with Davis-Bacon Act requirements and stringent workplace safety programs.

Section 5 - Job Quality

The most direct impact on the quality of employment for the 175 staff at Monticello High School will be in the category of worker health through improved air quality and reduced exposure to harmful chemicals and fumes resulting from the natural gas-burning boilers. We estimate that replacing the current gas-burning system with geothermal will avoid a number of criteria air pollutants (CAPs) and hazardous air pollutants (HAPs), namely:

- Carbon monoxide (CO, CAP) - 9,535 lbs. in 2030, and 41,446 lbs. in 2050
- Nitrogen dioxide (NO₂, CAP) - 2,783 lbs. in 2030, and 15,876 lbs. in 2050
- Particulate matter 10 (PM₁₀, CAP) - 56 lbs. in 2030, and 323 lbs. in 2050
- Particulate matter 2.5 (PM_{2.5}, CAP) - 1,257 lbs. in 2030, and 5,539 lbs. in 2050
- Sulfur dioxide (SO₂, CAP) - 37 lbs. in 2030, and 192 lbs. in 2050
- Benzene (HAP) - 72 lbs. by 2030, and 299 lbs. in 2050
- Formaldehyde (HAP) - 2 lbs. by 2030, and 8 lbs. by 2050

For new and existing employees, ACPS has a robust professional development program which provides professional and technical education to employees through internal and external courses. The program offers partial tuition reimbursement for employees who independently pursue additional educational opportunities. The division's career and technical education program offers hands-on learning opportunities in numerous fields, including its most recent cluster on the growing energy sector. Students are provided the opportunity to solidify those educational experiences with internships and apprenticeships within the division's operational departments.

In recent years, ACPS has strived to ensure that employees receive equitable and competitive pay and favorable working conditions. All full-time employees of Building Services are eligible to participate in the Virginia Retirement System's pension plan. In 2020, ACPS set an internal minimum wage of \$15/hour. Beginning in 2021, ACPS worked with a consultant to evaluate employee pay and benefits for all positions. Critical roles, including several within Building Services, were found to be lagging behind the market in pay and benefits, and employees in those positions received an increase immediately. Thanks to Albemarle County's robust economy, all employees received a 9% pay raise in 2022 and are expected to receive another 5 – 7% raise in 2023. Additionally, ACPS has worked with the survey giant Gallup to conduct surveys on employee satisfaction and engagement and has been diligently working to respond to areas identified for improvement.

Construction crews, including employees of contractors and subcontractors will be paid at or above local prevailing wages in compliance with the Davis-Bacon Act. All laborers will receive training prior to working onsite on project-specific topics including geothermal construction procedures, workplace safety, and other topics related to the project.

Workers will be required to have adequate certifications in their trade, and ACPS will require that at least one IGSHPA Certified GeoExchange Designer or Accredited Installer be part of the project team. Contractors must be licensed in their trade by the Virginia Department of Professional and Occupational Regulation (DPOR) and must prove that their firm has the requisite experience required to carry out a project of this scale.

Operations and maintenance staff are employed by ACPS and benefit from the same pay and professional development benefits as described in section 3.5.2, including fair wages with regular increases, opportunities for advancement, and good health care and retirement benefits. These benefits are no doubt among the contributors to the Building Services department's historically low turnover rate among maintenance employees. More than 35% of employees have been with the department for at least 10 years and the average length of service among current employees is 9.6 years. Employees receive regular training on a range of topics related to their positions including safety and technical training. Upon completion of the project, the prime contractor will be responsible for training maintenance personnel on the operations of the new systems as well as for providing a comprehensive operations and maintenance manual.

ACPS supports its employees' option to engage in collective bargaining. As a Dillion Rule state, Virginia localities – including ACPS – are granted their authority by the state General Assembly. In 2020, ACPS reinstated the ability of their employees to engage in collective bargaining. As one of the earliest local government entities in the state to take steps towards collective bargaining on behalf of its employees, ACPS employees are provided free and fair access to union membership. ACPS is currently in negotiations with the local trade union, and final resolutions are expected in late 2023. The Albemarle Education Association (AEA), a local affiliate of the Virginia and National Education Association, is the primary union with which ACPS employees engage. Building Services, the lead department on this proposed project, hosted a table for AEA at its 2022 annual meeting to provide employees free and fair access to union representatives.

Section 6 - Programmatic Capability and Past Performance

6.A Past Performance

ACPS has an extensive history managing the reporting and compliance requirements of state and federal grants and assistance funds. Within the past three years, ACPS has been awarded and complied with reporting requirements of the following awards:

- Clean School Bus Program – Round 1
 - Virginia Department of Environmental Quality
 - Received \$486,770 from Volkswagen Environmental Mitigation Trust funding to purchase two electric school buses and associated charging infrastructure. Funds were reimbursed at the completion of the project with quarterly progress reports required
 - Contact: Angela Conroy, Senior Planner (Angela.Conroy@deq.virginia.gov)
- Clean School Bus Program – Round 2
 - Virginia Department of Environmental Quality
 - Received \$464,754 from Volkswagen Environmental Mitigation Trust funding to purchase two electric school buses and associated charging infrastructure. Funds were reimbursed at the completion of the project with quarterly progress reports required.
 - Contact: Angela Conroy, Senior Planner (Angela.Conroy@deq.virginia.gov)
- American Rescue Plan Act Coronavirus State and Local Fiscal Recovery Funds (CSLFRF)
 - Virginia Department of Education
 - CFDA: 21.027
 - Received \$2,725,262 to support ventilation replacement and improvement projects in public school facilities.
 - Contact: Susan Dandridge, Grants Manager (Susan.Dandridge@doe.virginia.gov)
- Energy CLASS Prize
 - US Department of Energy, State and Community Energy Programs
 - Awarded a \$100,000 prize to support energy management staffing and energy efficiency programs.
 - Contact: Andrea Swiatocha, Schools Program Manager, State and Community Energy Program (andrea.swiatocha@hq.doe.gov)

Albemarle County Public Schools and Albemarle County have a post-award process that monitors and ensures compliance for timely grant reporting. We have maintained compliance for the above grants. Our annual single audit also ensures we are meeting the most updated Governmental Accounting Standards Board (GASB) requirements for compliance and reporting.

6.B Reporting Requirements

- Clean School Bus Program – Round 1
 - Progress Reports were required quarterly throughout the duration of the project. All progress reports were submitted on time and included the information required to show progress towards acquisition of electric buses and charging infrastructure.
 - ACPS was fully transparent about delays to the project including extended lead times for equipment purchases.
- Clean School Bus Program – Round 2
 - Progress Reports were required quarterly throughout the duration of the project. All progress reports were submitted on time and included the information required to show progress towards acquisition of electric buses and charging infrastructure.
 - ACPS was fully transparent about delays to the project including extended lead times for equipment purchases.
- American Rescue Plan Act Coronavirus State and Local Fiscal Recovery Funds (CSLFRF)
 - This grant did not have formal requirements for progress reporting; however, all grant records and financial statements are subject to audit from the Virginia Department of Education. As such ACPS has taken care to ensure compliance with all record keeping requirements.
- Energy CLASS Prize
 - The Energy CLASS Prize is a two-phase program. Phase 1 entailed an application and award of competitive prizes. Prizes funds were given with no conditions upon use of funds, performance periods, or reporting requirements. However, ACPS, as a Phase 1 awardee, needed to attend a series of educational webinars and coaching meetings in order to be eligible for the phase 2 award. The ACPS team has had at least one team member, and often multiple team members present for each training and coaching event.

6.C Staff Expertise

Lindsay Snoddy serves as Director of Building Services for Albemarle County Public Schools. She is a professional engineer with over 17 years of facility management and sustainability experience. She leads a team of more than 200 facilities professionals. Lindsay has overseen numerous relevant projects including the renovation of and additions to Crozet Elementary, which included the school division's first geothermal HVAC system. Lindsay received a master's degree in civil engineering from Georgia Tech University.

Matt Wertman is the Deputy Director of Building Services for Albemarle County Public Schools. He has extensive experience as a project manager in the design and construction industry and leads the School Division's team of project managers that are responsible for the execution of the schools' capital improvements program. As an owner's representative, Matt is committed to helping advance the School Division's mission "...to ensure that every student succeeds". Matt's role on this project will be to facilitate

the full design, construction, and close-out as the Owner's Representative. Matt has a bachelor's degree in architecture from the University of Virginia and a Master of Business Administration from Penn State

John Coles is the Environmental Program Manager for Albemarle County Public Schools, Department of Building Services. John is responsible for identifying and developing projects across departmental silos to reduce the school division's GHG emissions. He leads the School Board's Advisory Committee for Environmental Sustainability. John serves as the school division's energy manager, working to reduce energy consumption and emissions. John has a master's degree in Geographic Information Systems from Penn State.

Gabe Dayley serves as Climate Protection Program Manager for Albemarle County, Virginia. In this position, he is responsible for managing implementation of the County's Climate Action Plan to reduce community greenhouse gas emissions and for developing climate resilience strategies to prepare for the local impacts of climate change. This work includes facilitating collaboration across local government, public schools, and community stakeholders to achieve climate action goals while equitably advancing local health, wellbeing, and prosperity. Gabe received a master's degree in international Peace and Conflict Resolution from American University and a bachelor's in international relations from Pomona College. His graduate work focused on the application of conflict transformation to tackling environmental challenges.

James Powers serves as Climate Protection Project Manager for Albemarle County. He brings extensive experience engaging rural communities and agricultural producers to support adoption of regenerative practices. James cultivated partnerships with over 70 agricultural organizations and other key stakeholders in an inclusive, multi-state coalition to negotiate and advocate for bipartisan federal climate policy with Congressional legislators. He led a team that designed, implemented, documented, and evaluated collaborative partnership strategies and processes that leverage the collective insights of diverse, nationally-influential agricultural organizations and farmer-leaders. He facilitated Steering Committee monthly meetings to develop program vision and agenda, and coordinate policy refinement, engagement, and political strategy.

Section 7 - Budget

7.A Budget Detail

Full budget details are included in the attached Budget Spreadsheet. Expended expenditures fall within three of the budget categories, personnel, equipment, and indirect charges.

The total project budget is estimated at \$25,293,825. The following budget categories were used:

- One new staff member is proposed at 0.5 FTE to assist with the compliance and reporting requirements associated with the project. The starting salary would be \$27,500 and is projected to increase by 3% annually.
- Equipment comprises the majority of the project's budget. Equipment line items include associated construction and/or installation costs in the line-item cost. Therefore, separate construction/installation costs are not broken out elsewhere. Costs are incorporated into two major categories, Geothermal Well Field and MEP Upgrades. Equipment costs are based on

pricing that was provided by a third-party vendor following the preliminary design of the systems. The total costs for equipment are \$18,869,000 spread over three years.

- Indirect costs include design fees and additional costs associated with the project's general contractor and are calculated as a percentage of the project's equipment costs. Total Indirect costs are estimated to be \$6,339,825. Indirect costs include:
 - 15% for design;
 - 8% for general contractor contingency;
 - 7% for general contractor overhead and profit; and
 - 2.5% for general contractor bonds and insurance.

7.B Expenditure of Awarded Funds

ACPS has a full team of project managers skilled in managing the design and construction of large capital projects from concept to closeout, including the recent construction of an elementary school addition that included installation of a new geothermal system.

ACPS has a rigorous quality assurance and control procedure and strives for a high level of quality in all projects. Regular drawing reviews, written checklists, and meetings with the operations and maintenance teams enable our team to avoid undesired design components, which can be problematic – and costly – in the future. Once a project reaches the construction phase, the team's project managers take a proactive approach, including conducting daily site inspections to catch issues before they progress and to ensure that the quality of work being performed is top notch. ACPS also typically implements a high level of materials testing on all projects to ensure the materials supplied meet the performance specifications required to deliver optimal operational performance at the conclusion of the project.

7.C Reasonableness of Costs

To estimate cost data, we commissioned a geothermal well cost study from Axias, Inc. The unit pricing is based upon a combination of sources that include but not limited to the following:

- Local historical costs for similar projects of size and location;
- Vendor quotes;
- Industry-recognized cost pricing databases such as RS Means (used only as a general guide); and
- Estimator Judgment - many of the prices used are the result of first principles estimating, a determination of the actual time required to perform the activity using local labor rates, plus material costs that reflect the typically small quantities required, plus equipment rental costs as applicable.

Subcontractor mark-ups have been included in each line item unit price. These markups cover the cost of home office overhead and profit. We assume mark-up rates as follows:

- 15% for design contingency;
- 8% for general contingency and requirements;
- 7% for overhead and profit; and
- 2.5% for bonds and insurance.

We assume a competitive bid with at least three general contractors and at least three subcontractors at every trade. We assume normal working hours for the duration of construction and no restriction on working access to the project.

The following costs are not included in this assessment:

- Site clearance and grading, which would be under a separate contract;
- Escalation
- Construction contingency (for changes during construction)
- Unforeseen conditions
- Non-competitive bids
- Sole-source specifications of materials or products
- Offsite work
- Design and consultant fees
- Special site security requirements

References

¹[https://studiesviriniageneralassembly.s3.amazonaws.com/meeting_docs/documents/000/000/979/original/Needs and Conditions of Virginia School Buildings 6.3.21.pdf?1622733329](https://studiesviriniageneralassembly.s3.amazonaws.com/meeting_docs/documents/000/000/979/original/Needs_and_Conditions_of_Virginia_School_Buildings_6.3.21.pdf?1622733329)

²<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10001863/>

³https://journals.lww.com/epidem/fulltext/2013/03000/household_levels_of_nitrogen_dioxide_and_pediatric.21.aspx